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(54) Large scale illuminated display

(57) A large scale two-dimensional display comprises a set of one-dimensional display components 11 located side-by-side in the other dimension each component being a multiconductor ribbon cable 12 hanging vertically from a suspension point, such as bar 15, and having display elements 17 attached along its length by way of insulation piercing connectors. The cable conductors are selectively energised to form the display by shifting switching signals along the cables by way of shift registers. The illumination elements 17 may comprise an array of high intensity l.e.d's of red and green emission. The components may be gathered, e.g. rolled, to vary the display height. The illumination elements may be light reflective and energised by electro-optical or electro-mechanical shuttering. The display format is determined by a microcomputer with inputs from an alphanumeric k yboard or a graphic tablet.

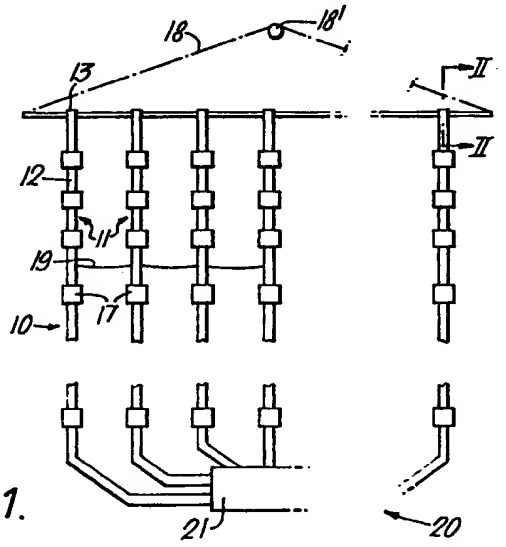

Fig.1.

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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

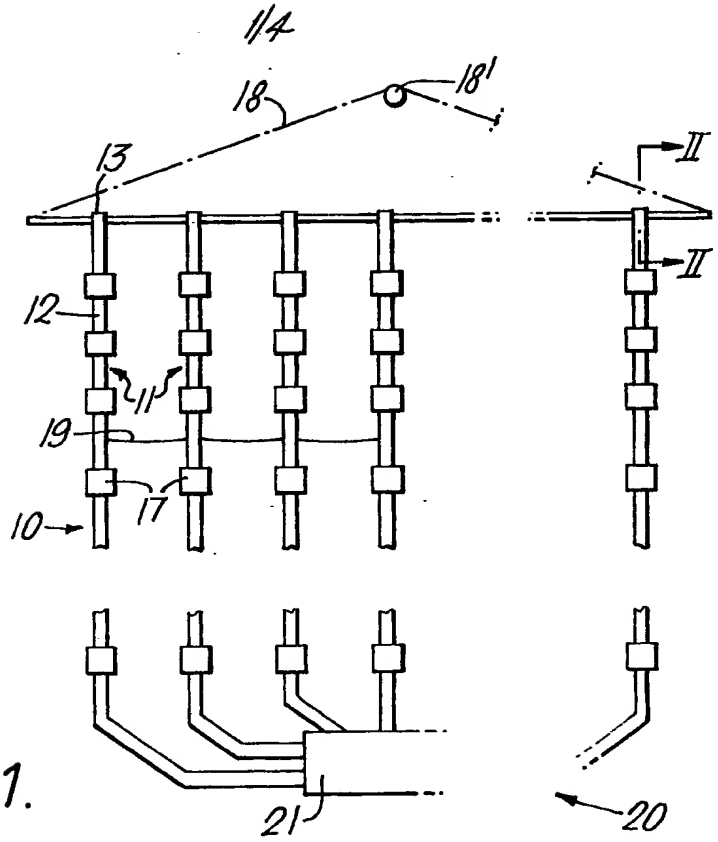

Fig. 1.

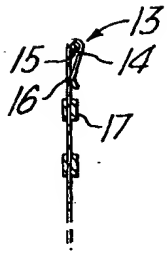

Fig. 2.

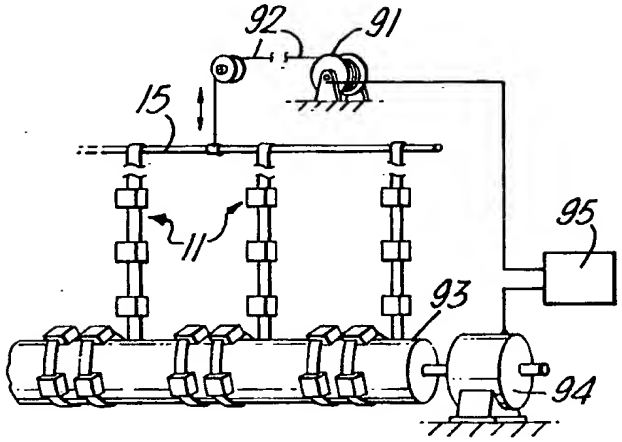

Fig. 9.

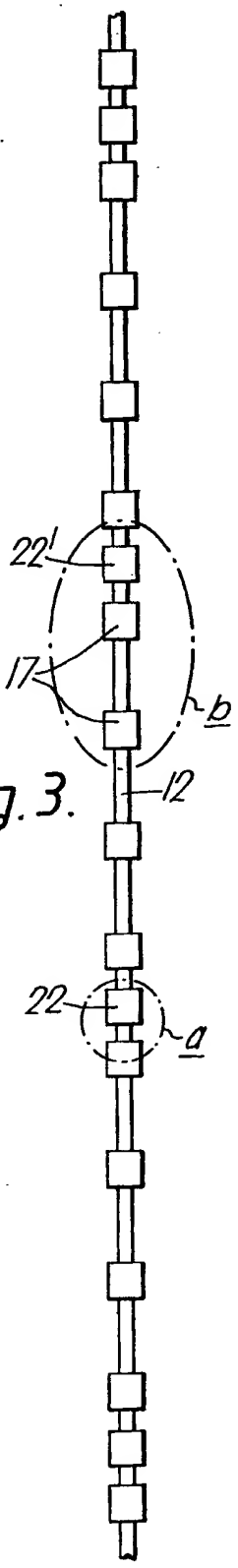

Fig. 3.

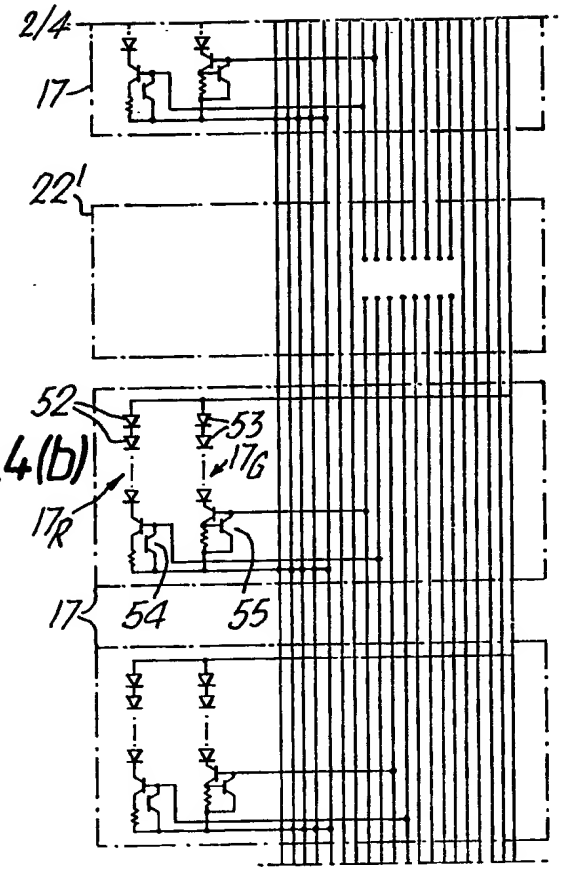

Fig.4(b)

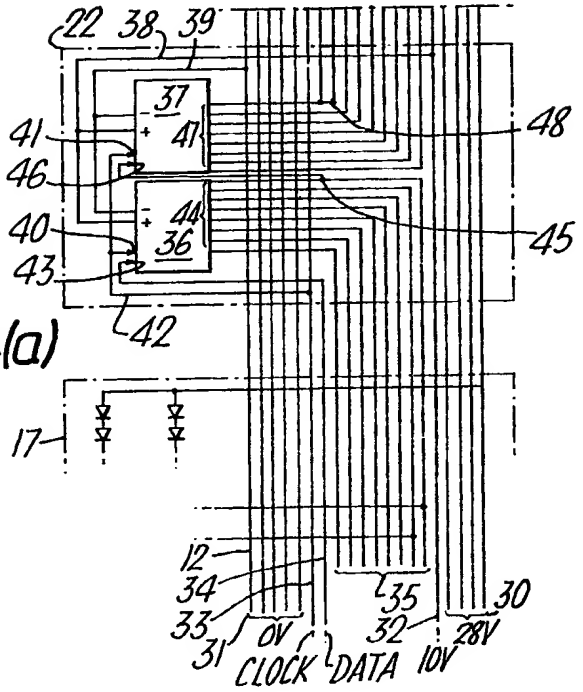

Fig.4(a)

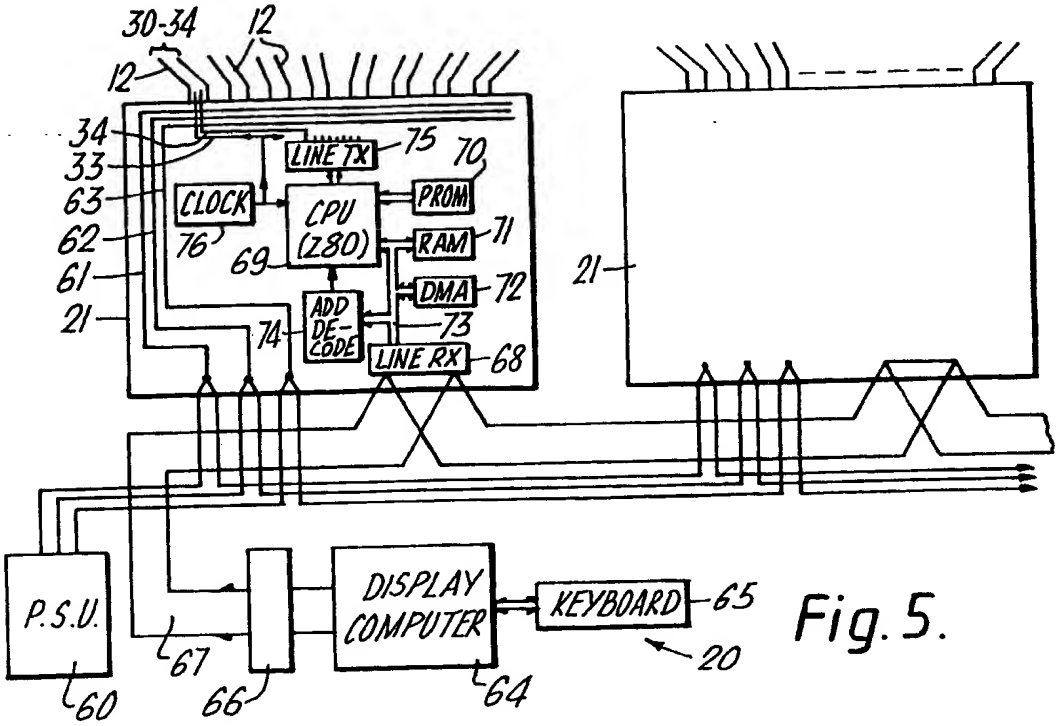

Fig. 5.

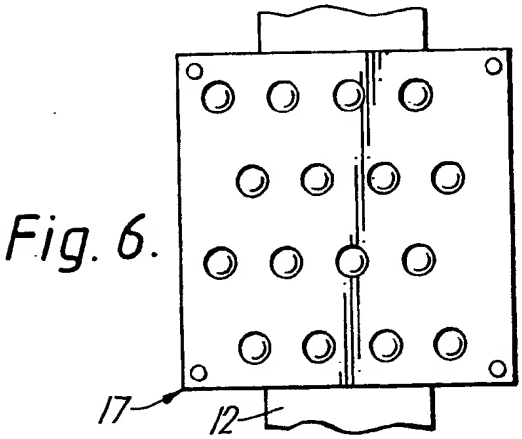

Fig. 6.

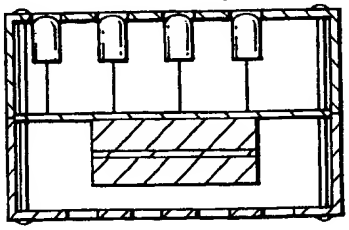

Fig. 7.

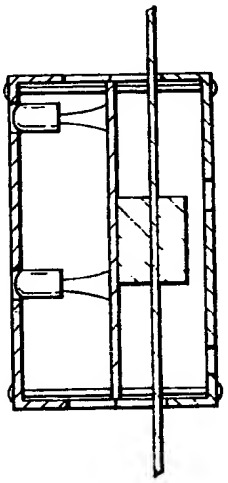

Fig. 8.

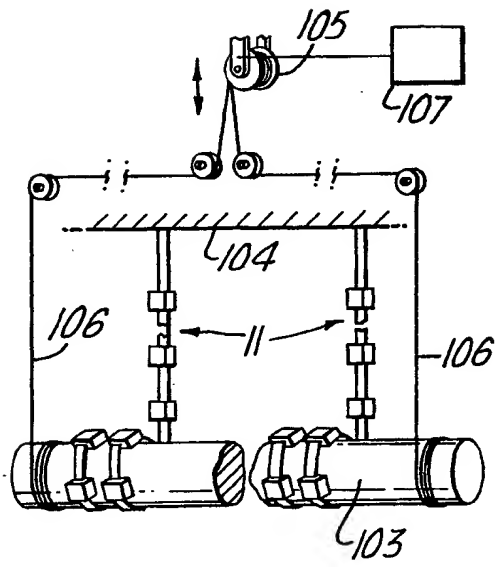

Fig. 10.

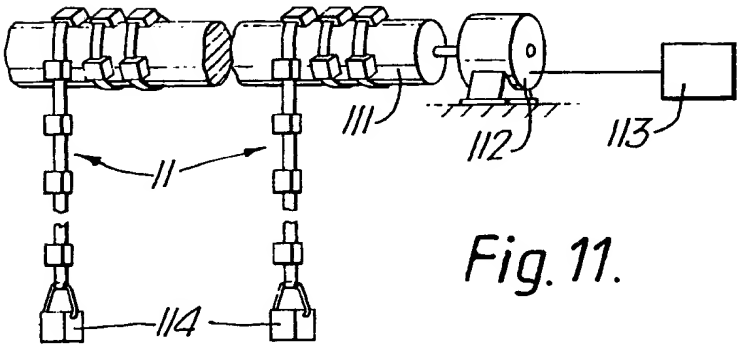

Fig. 11.

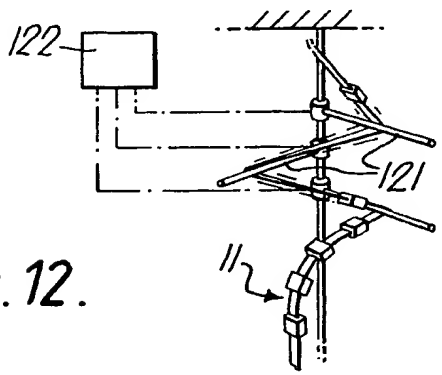

Fig. 12.

SPECIFICATION

Large scale energisable display

This invention relates to energisable displays and in particular to a relatively large scale display formed by a two-dimensional array of discrete energisable display elements.

In this specification the term 'energisable' is used in relation to a form of display or display element which when energised changes its appearance, e.g. by physically positioning or shuttering a portion of different reflectivity or by emitting light (also called illuminated).

The invention is concerned particularly, but not exclusively, with an energisable display suitable for mounting on an expansive surface of a structure, such as a building, where the dimensions required for distant further viewing of the display necessitate a display area of several tens of square metres.

It is desirable in such a display, which inevitably consists of a large number of component parts, that these component parts be as similar to each other as possible. Furthermore it is desirable that such a display should have a construction requiring minimal disturbance to any structure with which it is used.

It is an object of the present invention to provide a two-dimensional energisable display of simple construction fulfilling the above outlined requirements.

According to the present invention a two-dimensional energisable display comprises a set of one-dimensional display components located side-by-side in the other dimension of the display, each display component comprising a multiconductor flexible electrical cable hanging substantially vertically from a suspension point and having illumination elements attached to appropriate conductors thereof at intervals along its length, and electrical display driving means connected to supply energising signals by way of the cable to the display components in accordance with the formation of a desired two-dimensional display of energised elements.

An energisable display according to the present invention may include height varying means operable to vary the suspended height of such display component and to gather that portion not forming the suspended length.

Such a construction enables the display to be adjusted in height to suit different structure or display requirements and/or to be completely gathered when not in use enabling it to be used temporarily for example, extending over the face of a windowed office building outside of office hours, or suspended by a mobile framework at a temporary 'site'.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a front view of a portion of an illuminated energisable display according to the present invention showing the construction and relative disposition of display components,

Figure 2 is a sectional elevation through the suspension point of one display element taken along the line I-I of Figure 1,

Figure 3 is a more detailed view of a portion of one display component,

Figures 4(a) and 4(b) are schematic representations of the electrical circuit arrangement of the portions of display component of Figure 3 shown ringed,

Figure 5 is a block circuit diagram of a portion of the display drawing means,

Figure 6 is a front view of one of the display elements,

Figure 7 is a sectional end elevation of the display element of Figure 6,

Figure 8 is a sectional side elevation of the display element of Figure 6,

Figure 9 is a schematically perspective view of an illuminated display according to the present invention which is variable in height by drawing the suspended lengths of cable up from drum gathering means,

Figure 10 is a view similar to Figure 3 but showing the gathering means suspended with the display components,

Figure 11 is a schematically perspective view showing a drum gathering means from which the display components are suspended, and

Figure 12 is a schematically perspective view similar to Figure 10 showing an alternative form of gathering means.

Referring to Figures 1 and 2 the display 10 comprises a set of one-dimensional vertically extending display components 11 located side-by-side in the horizontal dimension of the display. Each display component 11 comprises a continuous multiconductor flexible electrical cable 12, such as a flat ribbon cable, hanging from a suspension point 13. The suspension point is conveniently formed by a loop 14 of the cable wound over a suspension bar 15 and fastened to the hanging cable at 16.

Each display component carries a plurality of individual electrically energisable display elements 17, which in fact form a pair of illumination elements as will be described later, attached to the cable at intervals along its length by means of insulation piercing connectors (Fig. 4). The connectors mechanically secure each illumination element to the cable and also electrically connect it to receive electrical power from appropriate element addressing and energising conductors of the cable.

The individual display components 11 are all supported by a continuous suspension bar 15 which extends for the width of display and which is supported in some convenient manner in relation to a structure with which the display is used e.g. hung by cable 18 from a

fixture 18′ on the structure or affixed to the structure by brack ts 18″. It will be appreciat d that the precise form taken by the suspension point, wh ther a unitary construction as bar 15 or individual to each display component is open to variation which (except as specifically described hereinafter) do not concern the present invention.

In accordance with the present invention the one-dimensional display components and the cables thereof are connected to display driving means, shown generally at 19, comprising a driving computer and power supply unit 20 and for each group of display components a drive buffer 21.

Each display component also includes shift register means in the form of a plurality of shift register-carrying boards 22 and isolator boards 22′ distributed at intervals along the cable 12.

Referring to Figure 3 this shows a portion of one display component 17 in greater detail than Figure 1.

The multiconductor cable 12 is conveniently formed by a flat ribbon cable to which are connected at regularly spaced intervals display elements 17. Between each set of four successive display elements (that is, eight illumination elements) is a board of the distributed shift register means, the boards 22 and 22′ being disposed alternately.

The cable 12, ringed portion *a*, comprising a shift register board 22, and the ringed portion *b*, comprising an isolator board 22′ and two display elements 17, are shown in greater electrical detail in Figures 4(a) and 4(b) respectively.

The ribbon cable 12 requires thirteen separate conductors but to enable the supply of adequate current to the illumination elements while retaining minimal cable parameters a twenty-conductor cable is employed, four of said conductors comprising a 28 volt supply rail 30 and five of the conductors comprising a 0 volt return rail 31. Of the other conductors, one 32 comprises a 10 volt supply rail for the shift register boards 22, 33 carries clocking pulses to all the shift registers, 34 carries shift data from one shift register to the next and the eight conductors 35 connect the shift register outputs to the energising inputs of associated display elements.

Referring to Figure 4(a) a shift register board 22 contains two eight-bit shift registers 36 and 37 each connected by lines 38, 39 to power rails 32 and 31 and with clock inputs 40, 41 respectively connected by line 42 to clock rail 33.

Shift register 36 has a serial input terminal 43 to which the data line 34 is connected and ight stage outputs shown at 44 to which ar connected the eight conductors 35 ext nding downwardly of th board as shown in the Figure. Th high st stage output is connected at 45 to a serial input terminal 46 of the register 37. The register 37 also has eight stage outputs shown at 47 to which ar connect d the ight conductors 35 xtending upwardly of the board as shown in the Figure. The highest stage output is connected at 48 to a continuation of the serial data line 34 extending to the next shift register board.

Considering the eight outputs from shift register 37 the conductors 35 extend along the cable beyond four display elements (eight illumination elements) and are shown in Figure 4(b) terminating at an isolator board 22′. The same conductor group, electrically isolated extend from the next (higher) shift register (not shown) down to the isolator board, also serving eight illumination elements. The other conductors 30—34 continue unbroken through the isolator but may, for manufacturing reasons, form junctions between separate cable lengths.

Considering the display elements 17, each comprises two illumination elements 17_R, 17_G formed each by a serially connected string of high intensity light emitting diodes (52, 53) and an energising switch 54, 55 respectively connected between the power rails 30 and 31. The illumination elements are arranged to operate independently in accordance with energisation of the switch and to emit red or green light, or any combination thereof.

The diodes 52 for emitting red light are Stanley type SBR 5501 and the diodes 53 for emitting green light are Stanley type ESBG 5501. The different device types have different operating characteristics and it is convenient to develop an identical voltage drop of about 21 volts across each string by having in series 9 red emitting diodes 52 and 7 green emitting diodes 53.

For each display element, power supply connection is made by tapping the power rails 30 and 31 and the energising signals to the switches 54 and 55 are obtained by tapping the conductor group 35.

As stated above each section of conductors 35 is associated with eight illumination elements and the conductors are tapped by the element energising switches such that the switches disposed along the display component are energised in turn by successive stages of the shift register means.

The cables 12 of the diplay components of each group of eight are connected to a drive buffer 16 of the display driving means 19 and shown in greater detail in Figure 5.

The display driving means 19 c omprises a power source 60 having 0v, 10v and 28v outputs each connected to one of three p wer bus s 61, 62, 63 in the drive buffer 21.

The display format is determined within a suitably programmed microcomputer 64 from data inputs from an alphanumeric keyboard or graphical tablet indicated at 65. Th functioning of the computer and the program by which it op rates are not of importanc to an

understanding of the inv ntion and will not be described in detail but it is required to produce for each driv buffer a buffer identification code followed by a block of data in the form of a stream of 8-bit words, the number of words being equal to the number of elements of a display component. The buffer identification codes and data are transmitted in sequence for the number of drive buffers in the display and may be repeated cyclically or only when the display is to be changed, such as when new information is input.

The driving data is carried by way of an interface 66 on an interconnecting bus 67 which connects to each drive buffer 21 at a line receiver 68.

Each drive buffer comprises an 8-bit microprocessor CPU 69, such as a Zilog Z80 with a PROM 70 containing the operating instructions by which the buffer functions, a RAM 71 which comprises working memory for the CPU and storage area for the display defining words received from the computer 64 and a DMA controller 72 by which said words are loaded into the memory. An address/data bus 73 connects the line receiver 68 to the CPU and its peripheral devices and also to a decoder 74 which reponds to the identification code prefacing each block of data designating that buffer to interrupt the CPU and load the data into the RAM store.

The CPU also has an output data bus connected to a line transmitter 75 having eight outputs (one per bit of each 8-bit word from the CPU) and a clock 76 timing operation of the CPU.

The multiconductor cable 12 described in relation to Figure 4(a) with its conductors (or conductor group) 30—35 is connected to the drive buffer with the power conductors 30, 31 and 32 connected to the power buses 63, 61 and 62 respectively the clock line 33 connected to an output of clock 76 and the shift data line 34 connected to one output terminal of the transmitter 75. The other seven cables of adjacent display components are similarly connected, the only points of difference being the connection of the respective shift data lines to different outputs of the line transmitter 75. The conductor group 35 of each cable is merely anchored to the buffer board without electrical connection.

To produce a display the drive computer 64 sends blocks of words to each drive buffer in turn at high speed, which thereafter drive each group of display components in parallel. Each drive buffer reads the words from the RAM on at a time one applies one bit of ach to corresponding data lin 34 by way of the line transmitter 75. The words are r ad at a rate governed by clock 76 which also clocks the shift register means of the display components to shift the bits along the display component, addressing the energising switch 54 or 55 of each illumination element in turn until the number of w rds corresponding to the number of illumination elements have been read and shifted.

Clearly after each shift an energisati n signal is produced by a shift register output and some of the illumination elements are energised but to avoid emission of light the clocking rate is of sufficiently high rate that no visible display appears until the clocking is ended, at which time those illuminated elements energised comprise the display. Furthermore the display remains without refresh until it is desired to change the display.

It will be appreciated that if desired the information can be shifted along the display components at a slower rate becoming visible at each stage and appearing as a travelling message.

As stated the display is particularly suited to a large scale and where the display elements 17, which may be used in large numbers, are substantially identical in construction and readily secured within the electrical circuitry. Referring now to Figure 6(a) (b) and (c) these show in greater detail the physical construction of a display element 11 comprising, in the terminology of this specification, two illumination elements 17_R and 17_G. The display element comprises a circuit board 80 to the centre of which is soldered part of a stand-off insulation-piercing connector 81, which together with a second part attaches the display element 17 to the cable 12 and makes electrical connection to appropriate conductors of the cable. The circuit board 80 also carries the light sources of the illumination elements disposed in rows each side of the connector, the sources being said serially connected high intensity emitting diodes, 52 and 53 interspersed in position.

The circuit board and diodes are protected by a cover 82 of moulded thermoplastics material having apertures 83 therein corresponding to the disposition of the diode sources and through which the emitting ends of the diodes project. The cover also supports the diodes against bending of the leads by mechanical shock. Complementing the cover 82 is a base part 84 also formed as a thermoplastics moulding which protects the connector 81 and provides mechanical support therefor against lateral and rotational forces by cable entrance notches 85. The cover 82 and base part 84 may be formed by the same design of thermoplastics moulding, the apertures 83 in the base and notches 85 in the cover being redundant.

The cover 82 and base 84 may be joined separat ly to the circuit board 80 and/or to each other. Conveniently, the cover and bas are joined to each other, sandwiching the circuit board, by fastening pins 86 of thermoplastics mat rial which extend through aligned apertures in the corner of the cover and base and which are heat d and deformed to form

retaining heads 86'.

One of the problems of employing light emitting diodes as light sources to be viewed at large distances has been that the low level of intensities available. The above described light emitting diodes are constructed with internal optics which produce a relatively intense beam but concentrated to within a viewing angle of about 22'. The cover 82 of each illumination element serves to hold the diodes so that their optical axes are substantially parallel and directed as required perpendicularly to the circuit board 80.

The optical axes of the illumination elements are maintained substantially parallel by virtue of their construction and attachment to the cables, as described perpendicular to the plane of the display. However where the display is mounted high above ground level it may be desired to incline the optical axes to ensure that distant ground observers come within the viewing angle.

This may be achieved for instance by inclining the circuit board 80 with respect to the connector 81 and having different depths of cable notch 86 or by offsetting the apertures 83 within the cover 82 so that the diode sources 52, 53, in order to project into the recesses, have their optical axes inclined to the circuit board 80. Sources of illumination other than light emitting diodes having a restricted viewing angle may be employed.

Other variations which need not be discussed in detail may be made to the electrical addressing means, such as the drive buffers 21 being connected to the upper cable ends adjacent the suspension points, if this is more convenient.

It will be appreciated that the display, formed as it is from loosely joined display components themselves employing flexible cable, may be made variable in height to suit specific display needs. In particular the display may include height varying means operable to vary the suspended height of each display component and to gather that portion not forming the suspended length. Furthermore the display components may be completely gathered when not in use.

The height varying means comprises gathering means to effect said gathering of display components excessive to the display height under the control of controlling means.

Examples of some forms taken by the height varying means are shown in Figures 9 to 12 now described.

Referring to Figure 9, this shows part of a display in the form of three display components 11 suspended from a suspension bar 15 which is adjustable in vertical position by conventional means such as a winch 91 and cable 92. The lower portions of the display components are wound on a drum 93 of the gathering means, the drum being fixed in location but rotatable, at least in a sense to wind in the display components, by a drive motor 94. The display driving means (not shown) or at least the drive buffers for the display components is conveniently built into the drum and supplied conveniently by way of slip-rings or the like.

Controlling means 95 provides signals to the winch 91 and drive motor 94 of the gathering means whereby in order to define a new display height a length of display component is drawn of the drum 93 or is gathered on the drum by drive motor 94.

Figure 10 shows a similar arrangement in which the gathering means comprises a drum 103 on which the lower portions of the display components 11 are gathered. The upper ends of the display components are suspended from a suspension point 104 fixed in relation to the display and the gathering drum 103 is itself movable in position vertically to vary the suspended length of display components and to gather up lengths thereof excessive to the display height. The gathering drum is operated to control its height and rotation by a winch 105 and winch cables 106, wound onto the drum in an opposite sense to the display components under the control of controlling means 107.

In both of the above described embodiments the upper ends of the display components are connected to suspension points while the lower ends are associated with the gathering means.

Figure 11 shows an alternative arrangement in which the upper ends of the display components 11 are wound on a gathering drum 111, fixed in location relative to the display and rotatable about a horizontal axis by drive motor 112 under the control of controlling means 113. Gathering and extending of the display components is performed by rotation, of the drum in the appropriate sense by motor 112.

Conveniently the display driving means (not shown) is contained within the drum as described in relation to Figure 9, and the display components 11 arranged to be suspended by hanging from the gathered portion on the drum 111. The display components are preferably tensioned by weights 114 and maintained in relative position by linking members 19. The individual weight 114 may be replaced by a common weight bar (not shown) resulting in an arrangement similar to an inverted form of the arrangement of Figure 9, but without the winch 91.

The drum shown in Figures 9 to 11 represent only one form of gathering means. Figure 12 shows an arrangement similar to that of Figure 11 but in which the gathering means comprises a set of arms 121 vertically displaced in relation to each other and individually movable in a horizontal plane to divert and fold a portion (upper or lower) of each display component over each arm to gather

th portion in a fan fold. Th horizontal displacement of th arms 121 is governed by controlling means 122.

It will be appreciated that the display elements may be other than illuminated, that is, light emitting. They may for instance be light reflective, either with ambient or specially incident light, and energisable to display reflective properties by means of electro-optical or electromechanical shuttering. An example of such an element is the electromagnetic light reflective disk display proced by Ferranti-Packard Electronics Limited of Ontario, Canada.

Although not restricted to any specific dimensions the construction of the display is suited for instance to a display of overall dimensions say 4 metres × 25 metres formed by say 200 display components each comprising 32 display elements. Such a construction provides a rectangular array of display elements enabling energisation addresses to be readily determined. The distribution of display elements within each component or of display components may be varied in accordance with any specific display requirements.

CLAIMS

1. A two-dimensional energisable display comprising a set of one-dimensional display components located side-by-side in the other dimension of the display, each display component comprising a multiconductor flexible electrical cable hanging substantially vertically from a suspension point and having energisable display elements attached to appropriate conductors thereof at intervals along its length, and electrical display driving means connected to supply energising signals by way of the cable to the display components in accordance with the formation of a desired two-dimensional display of energised elements.

2. A display as claimed in claim 1 including height varying means operable to vary the suspended length of each display component and to gather that portion not forming the suspended length.

3. A display as claimed in claim 2 in which the height varying means comprises gathering means operable to gather up a portion of each display components excessive to the suspended length required and controlling means operable to move the gathering means and/or suspension point to effect a change in suspended length.

4. A display as claimed in claim 3 in which th gath ring means is fixed in location and is arranged to gather an upper portion of each display component, the gathered portion forming the suspensi n point for the suspended portion.

5. A display as claimed in claim 4 in which the distal end of each hanging display component carries a tensioning weight.

6. A display as claimed in claim 3 in which the gathering means is arranged to gather a low r portion of each display component at the end remote from the suspension point.

7. A display as claimed in claim 6 in which the gathering means is fixed in location and the suspension point of each display component raised and lowered relative thereto by the controlling means.

8. A display as claimed in claim 6 in which the suspension point is fixed and the controlling means is arranged to raise or lower the gathering means.

9. A display as claimed in any one of claims 3 to 8 in which the gathering means c omprises a drum rotatable about a substantially horizontal axis and about which all of the display components are wound to effect gathering.

10. A display as claimed in any one of claims 3 to 8 in which the gathering means comprises a set of arms vertically displaced in relation to each other and individually movable in a horizontal plane to divert and fold a portion of display component over each arm to gather the portion in a fan-fold.

11. A display as claimed in any one of the preceding claims in which the electrical display driving means is connected to one end of the cable of each display component.

12. A display as claimed in any one of the preceding claims in which the cable is a flat ribbon cable and the energisable display elements are supported by electrical contact made with appropriate conductors of the cable.

13. A display as claimed in claim 12 in which each energisable display element comprises an illumination element formed by an array of high intensity light sources.

14. A display as claimed in claim 13 in which the array comprises light sources of at least two different types able to enit light of different colours.

15. A display as claimed in claim 14 in which the different types of light sources are able to emit light of red and green colour.

16. A display device as claimed in any one of claims 13 to 15 in which in each display element the light sources are mounted on a circuit board and supported with their optical emission axes perpendicular thereto by a cover into which the sources project.

17. A display as claimed in claim 16 in which the cover is attached to a base part enclosing therebetween the source-carrying circuit board, the conductor and that a portion of cable adjacent the connector and coextensive with the circuit board.

18. A display as claimed in claim 17 in which th cover and base parts of the illumination element are joined by a plurality of fastening pins xtending by way of aligned apertures in the cov r and base parts and peened over externally thereof.

19. A display as claimed in claim 17 or claim 18 in which the cover and base parts are of substantially identical construction.

20. A display as claimed in any ne of claims 13 to 19 in which the light sources are high intensity light emitting diodes.

21. A display as claimed in claim 20 when dependent from claim 15 in which the light emitting diodes are Stanley types No SBR 5501 (red) and ESBG 5501 (green) respectively.

22. A display as claimed in any one of the preceding claims in which the display components are attached to adjacent display components by linking members.

23. A display as claimed in claim 22 in which the linking members are flexible and operable to limit the maximum separation between adjacent display components.

24. A two-dimensional illuminated display substantially as herein described with reference to Figures 1 to 8 or also in any one of Figures 9 to 12 of the accompanying drawings.

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